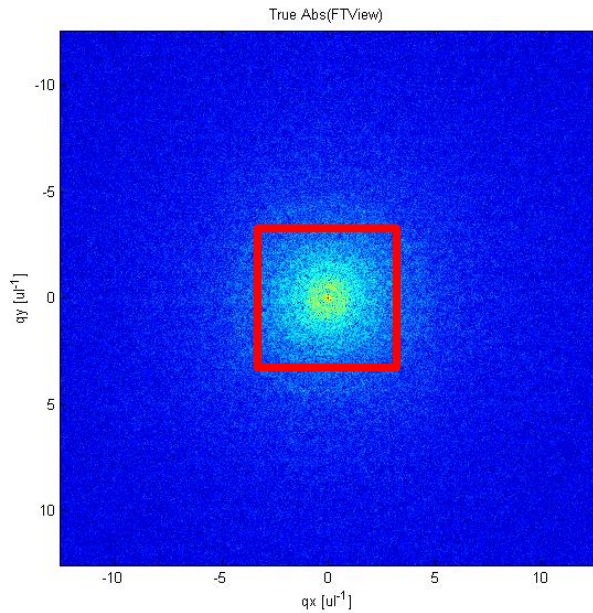


Resolution Estimates from Diffraction Measurements

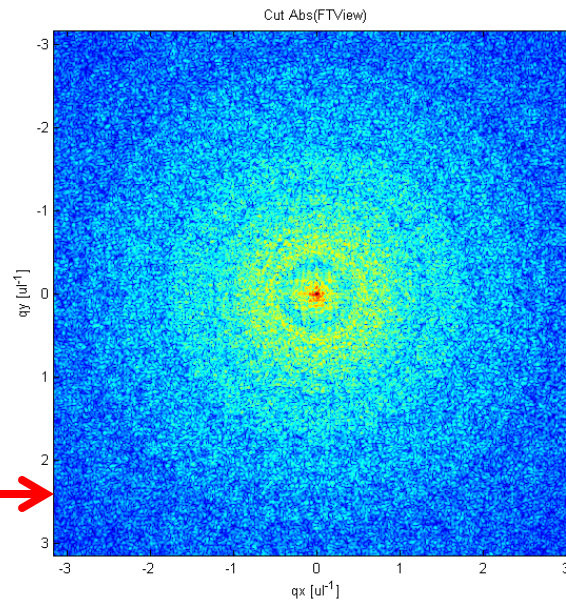
Sebastian Dietze

Shpyrko Group

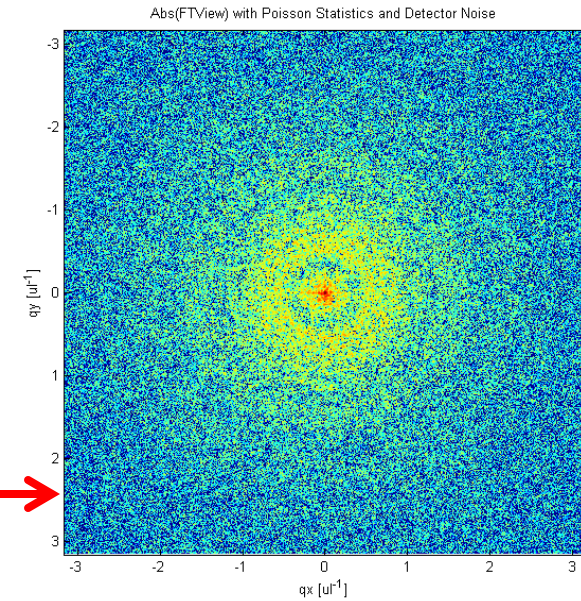
Model Data



FT of high resolution view



Cut to spatial frequencies
corresponding to 1u



Convert to Poisson Statistics
and add background noise

Reconstruction

- 500 total of [20 pPIE / 20 ePIE] + 200ER
- No constraints other than “measured” Fourier amplitudes and circular probe support.
- Probe positions are not periodic to avoid periodic artifacts
- Solution is shifted to center (translational invariance) and largest constant area set to phase of zero (constant phase invariance)

Approximation of Noise

Speckle

Normalized Noise

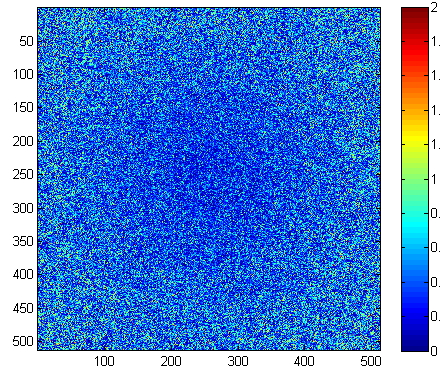
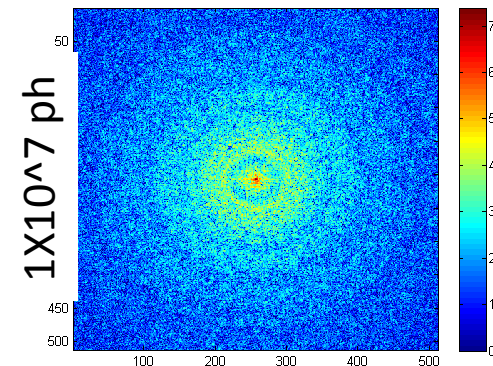
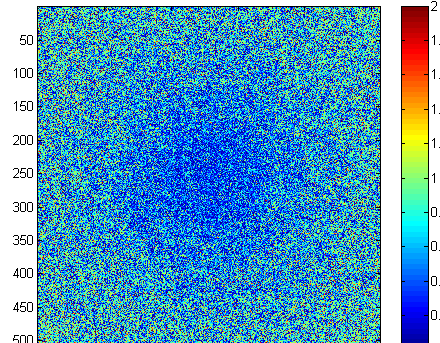
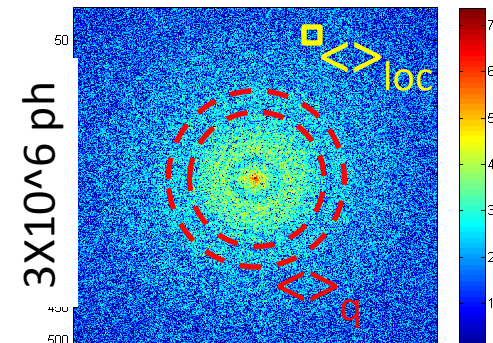
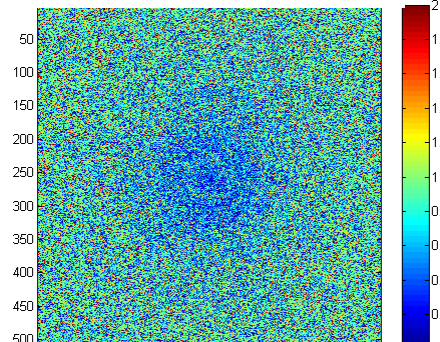
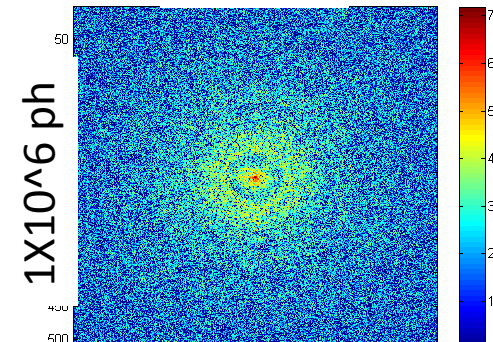
Normalized Standard Deviation

$$\frac{\sigma_q}{\langle S \rangle_q} = \frac{\sqrt{\langle S^2 \rangle_q - \langle S \rangle_q^2}}{\langle S \rangle_q}$$

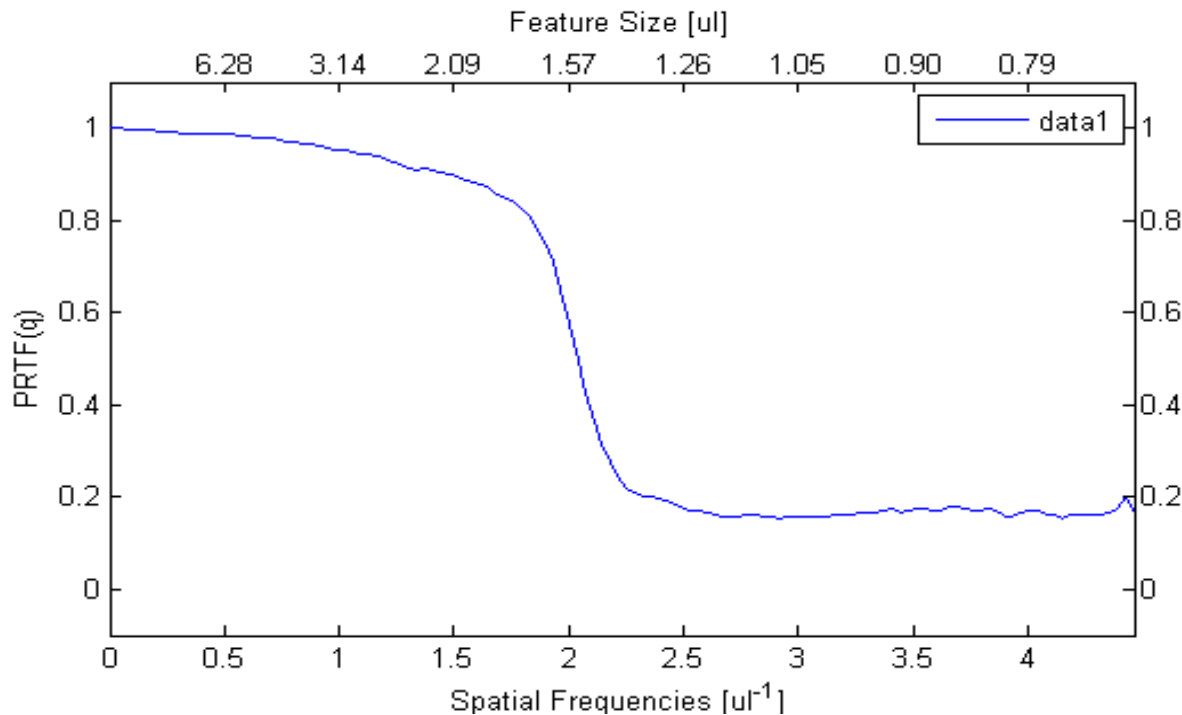
Average Noise to Signal ratio

$$\sqrt{\left\langle \frac{1}{SNR^2} \right\rangle_q} \approx \sqrt{\left\langle \frac{(S - \langle S \rangle_{loc})^2}{\langle S \rangle_{loc}^2} \right\rangle_q} \approx \frac{\sqrt{\langle S^2 \rangle_q - \langle S \rangle_q^2}}{\langle S \rangle_q}$$

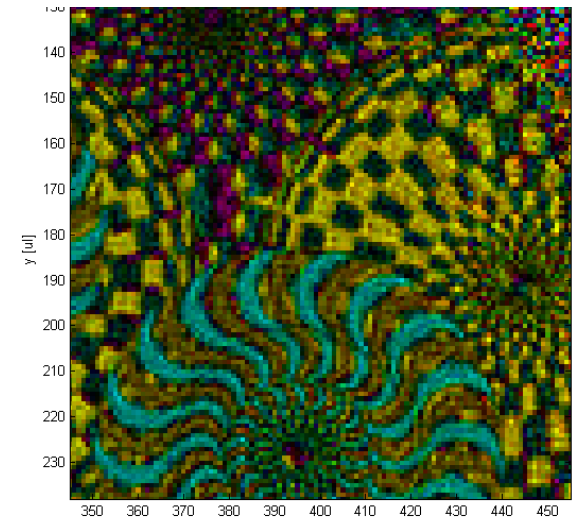
- Local normalization helps with Speckle and asymmetry
- Result Depends on local region chosen



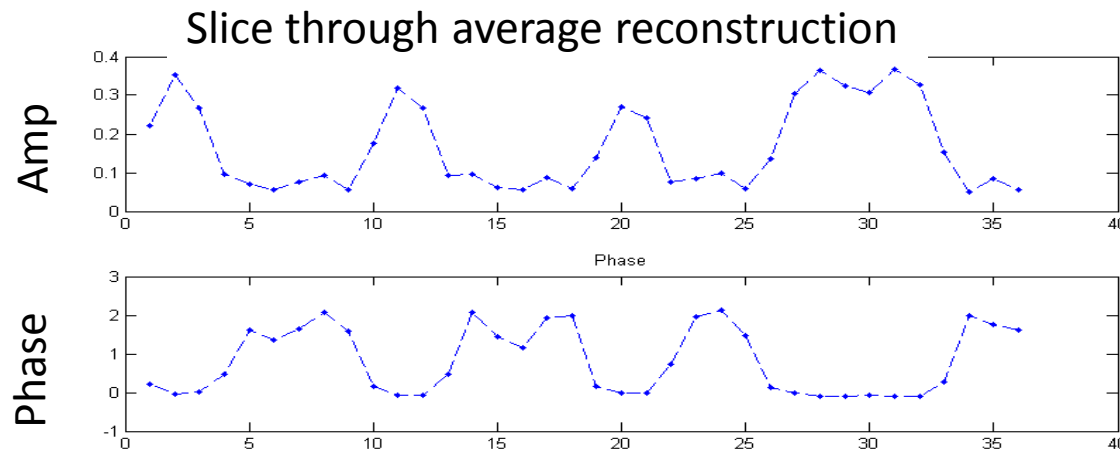
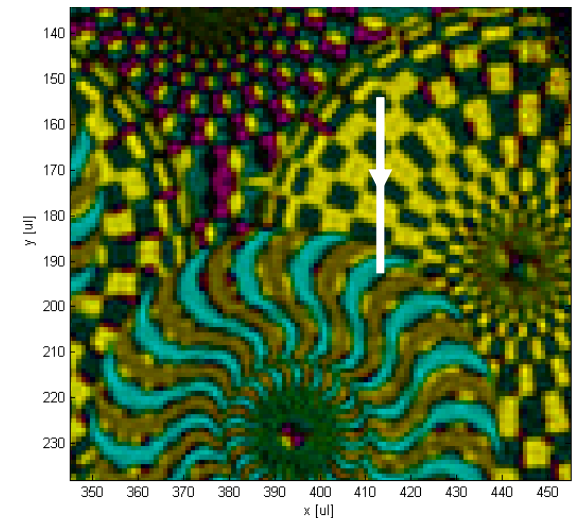
Judging Reconstruction Resolution from PRTF



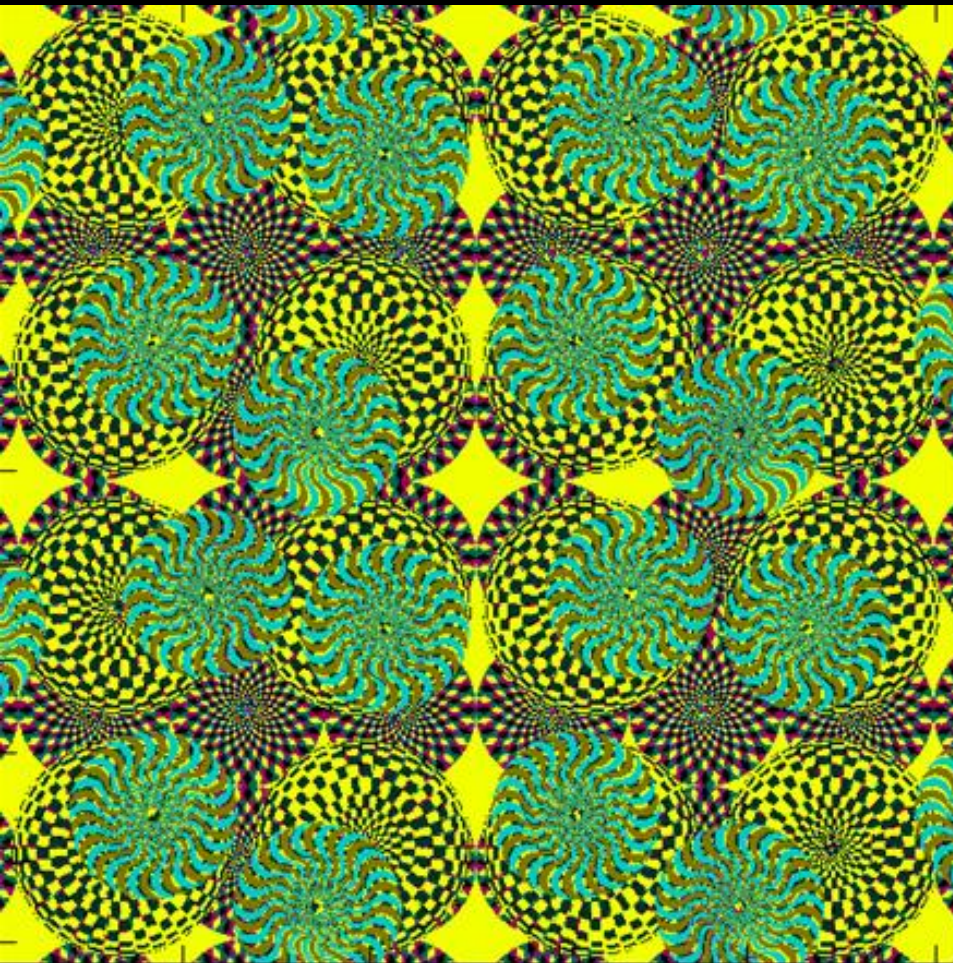
Single Reconstruction with 10^7 ph



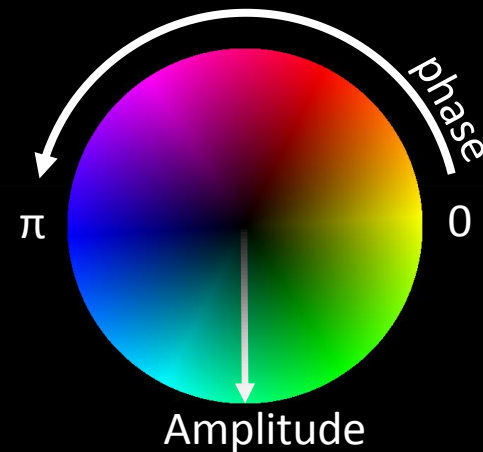
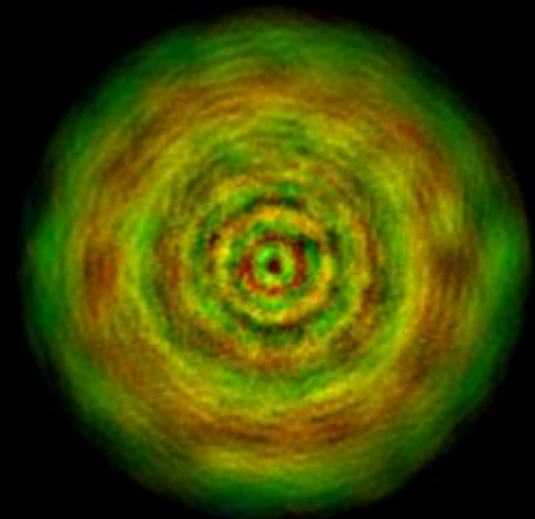
Average of 30 Reconstructions



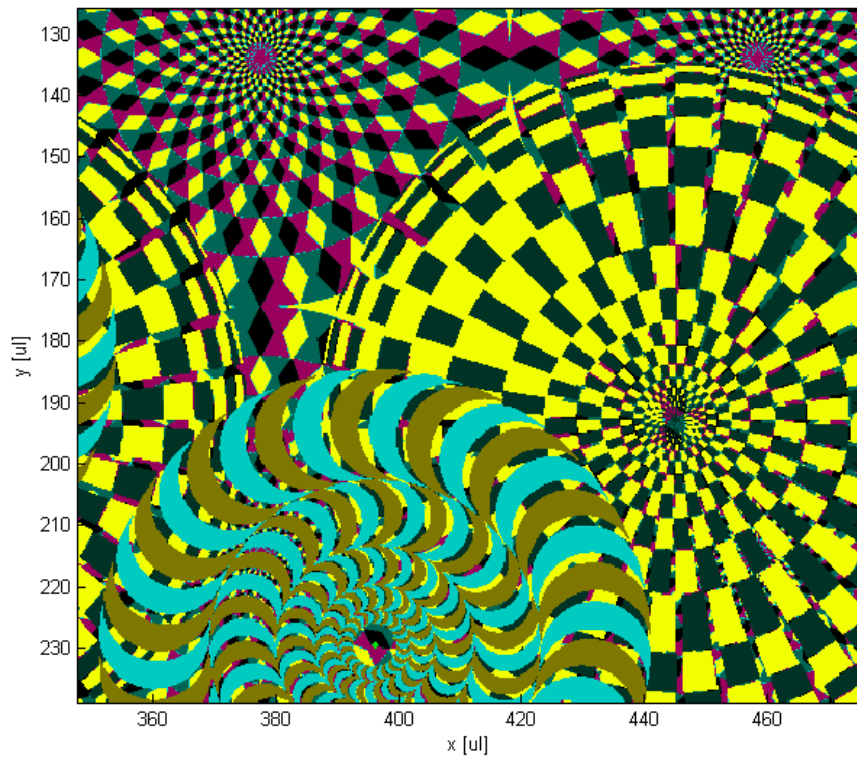
Test Object and Probe



100 μ l

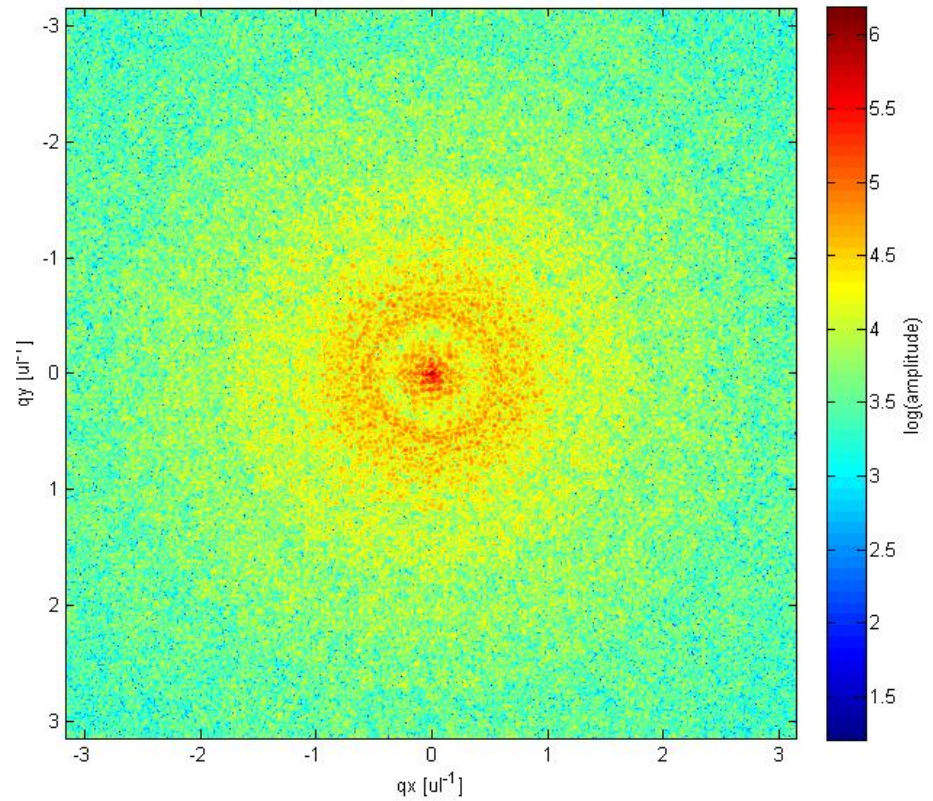


Close up of Complex Object

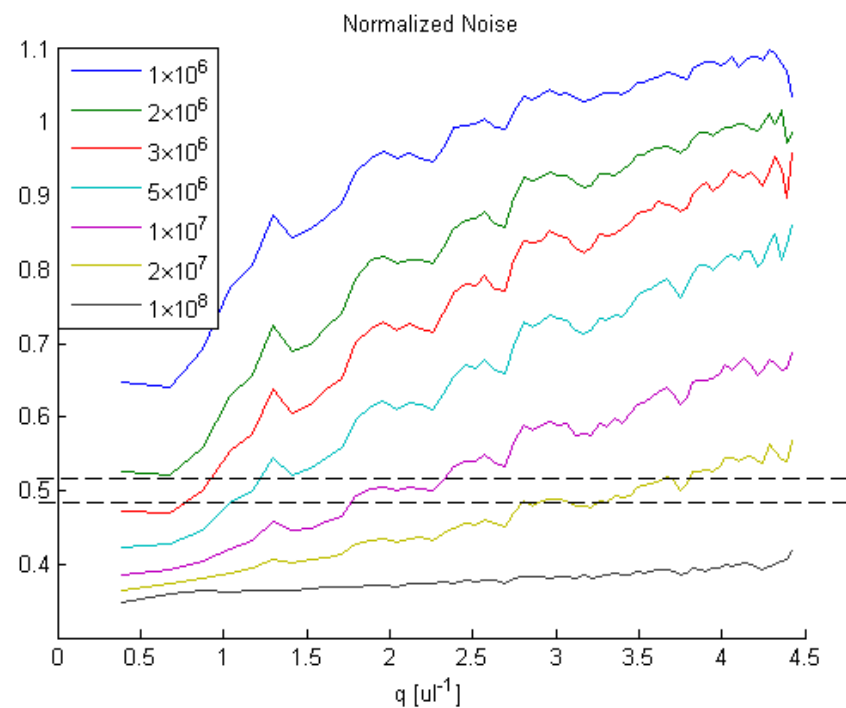
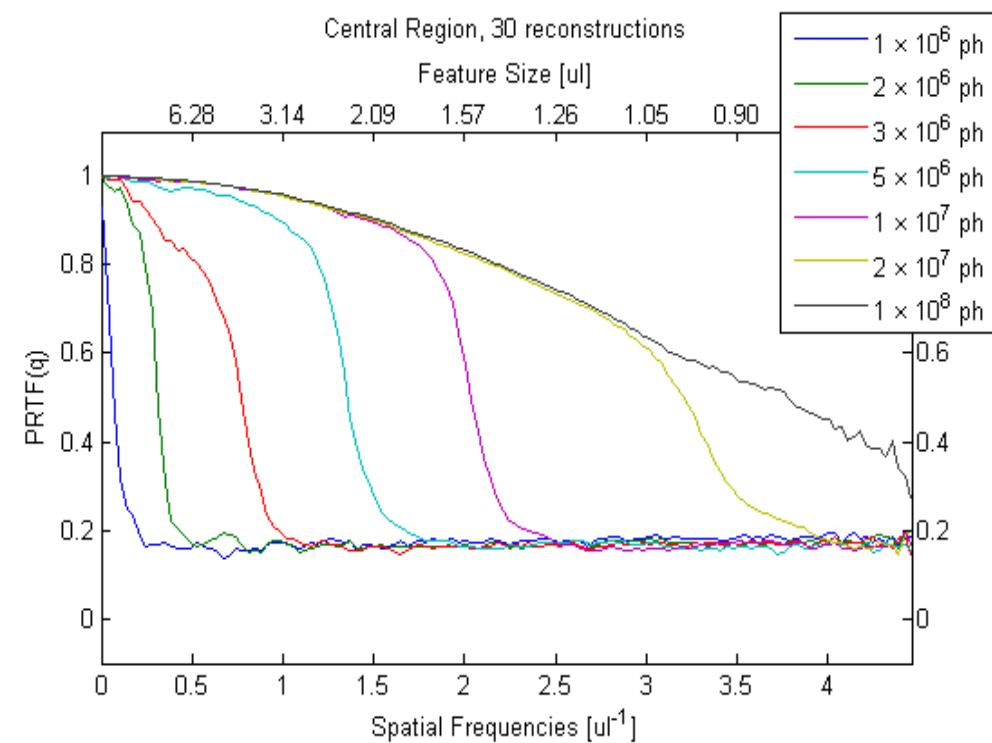


Easily recognizable structures of varying size

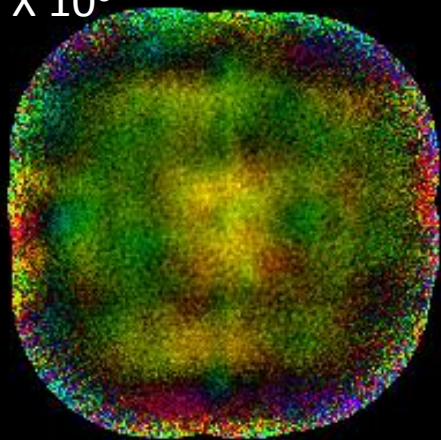
Abs(FTView)



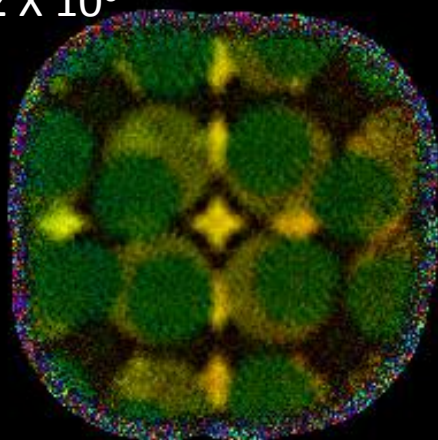
Good spread in spatial frequency



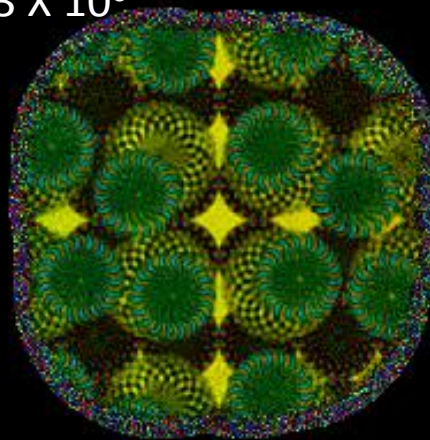
1×10^6



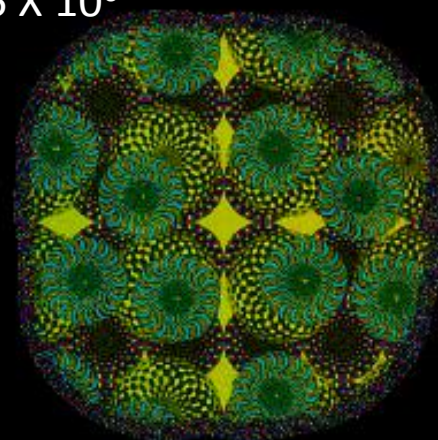
2×10^6



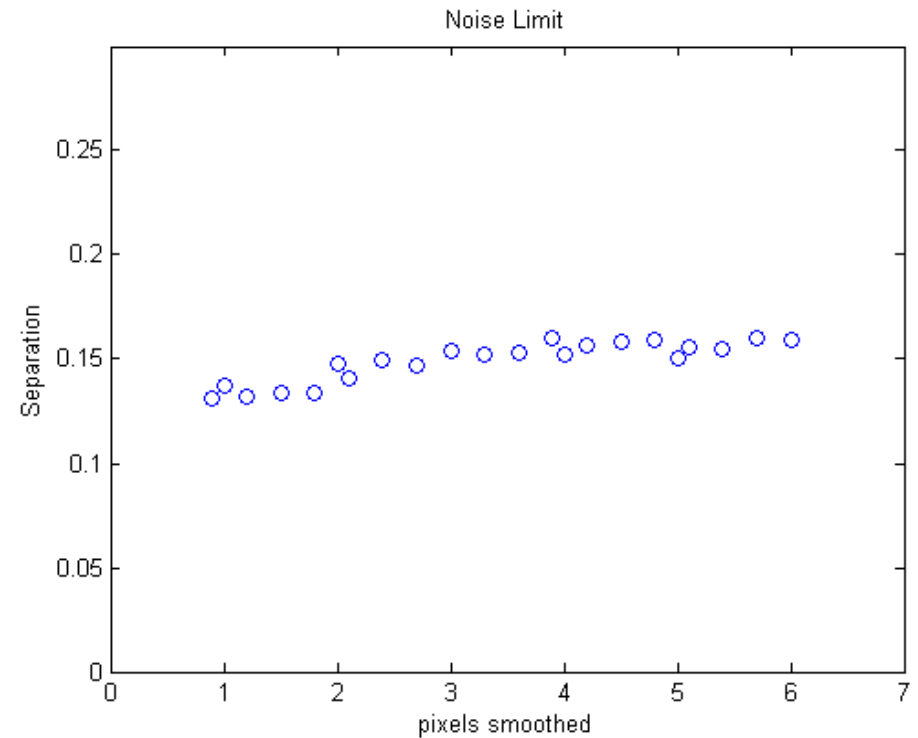
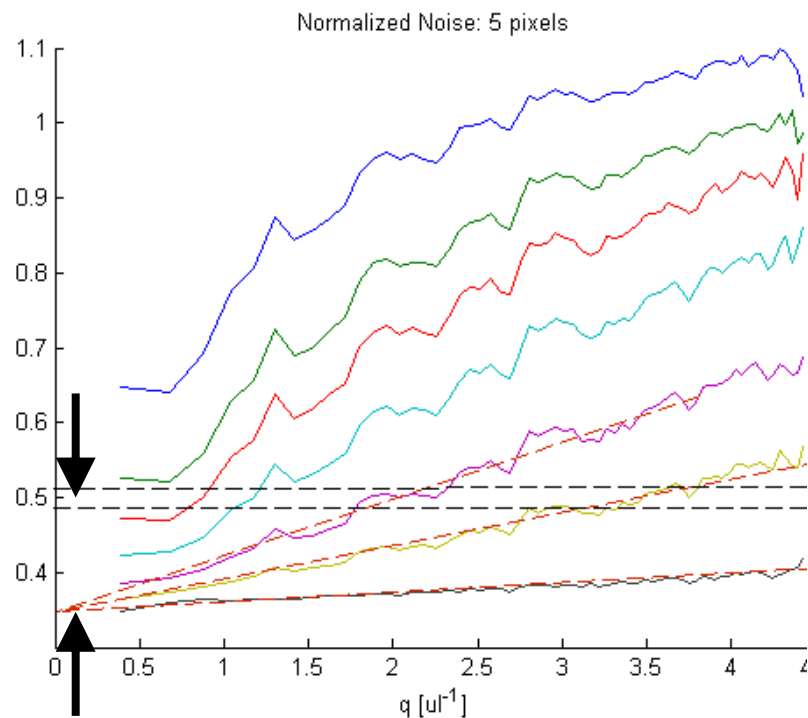
3×10^6



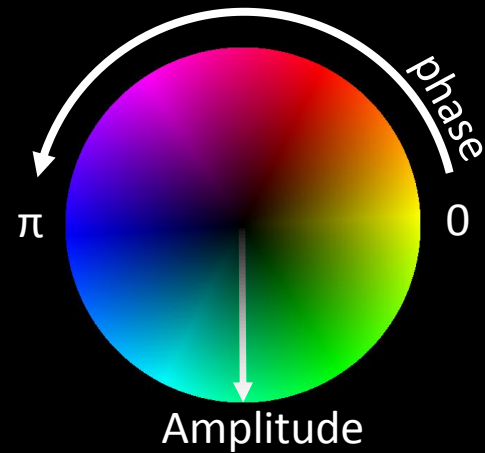
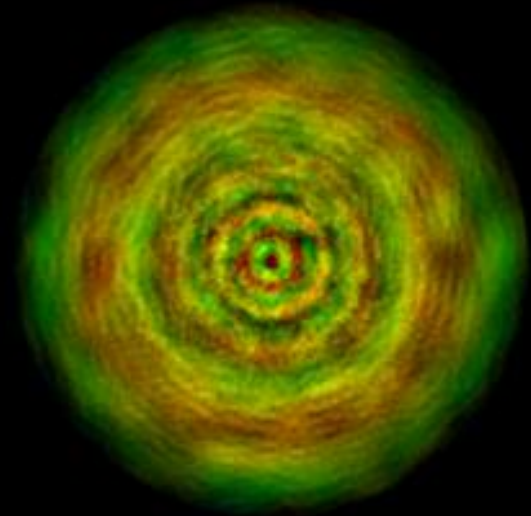
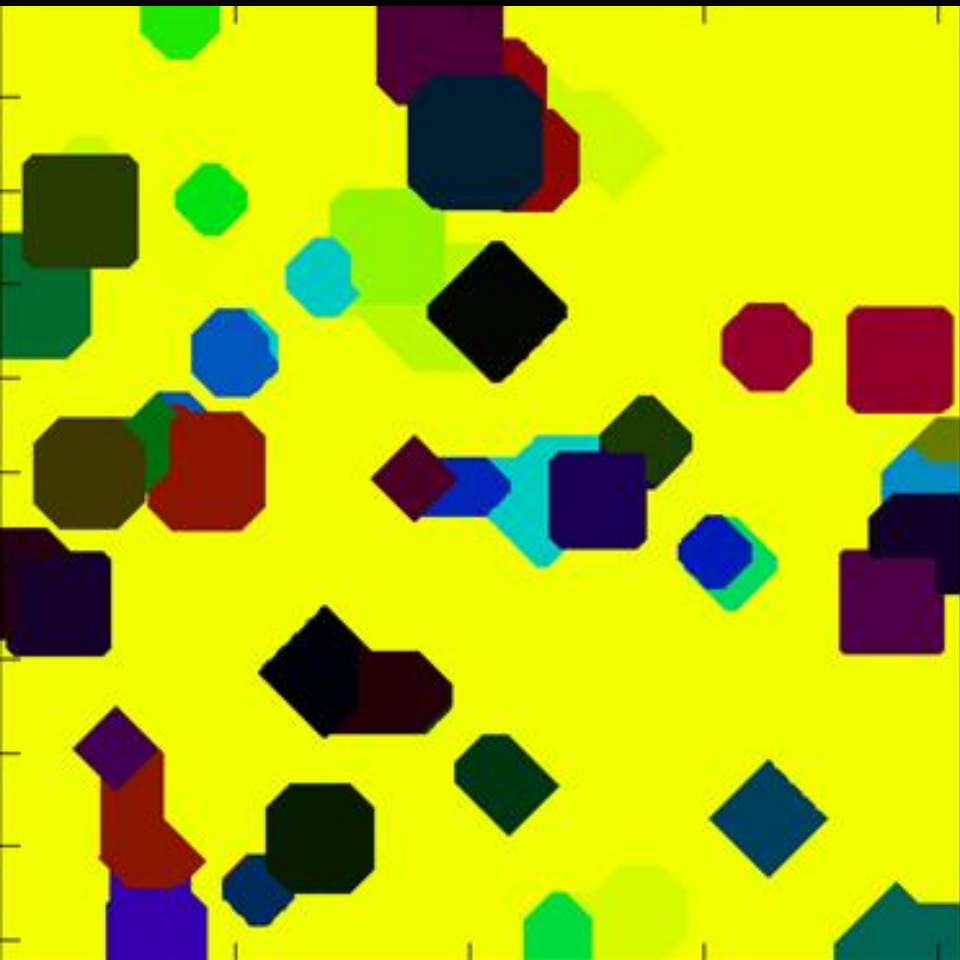
5×10^6



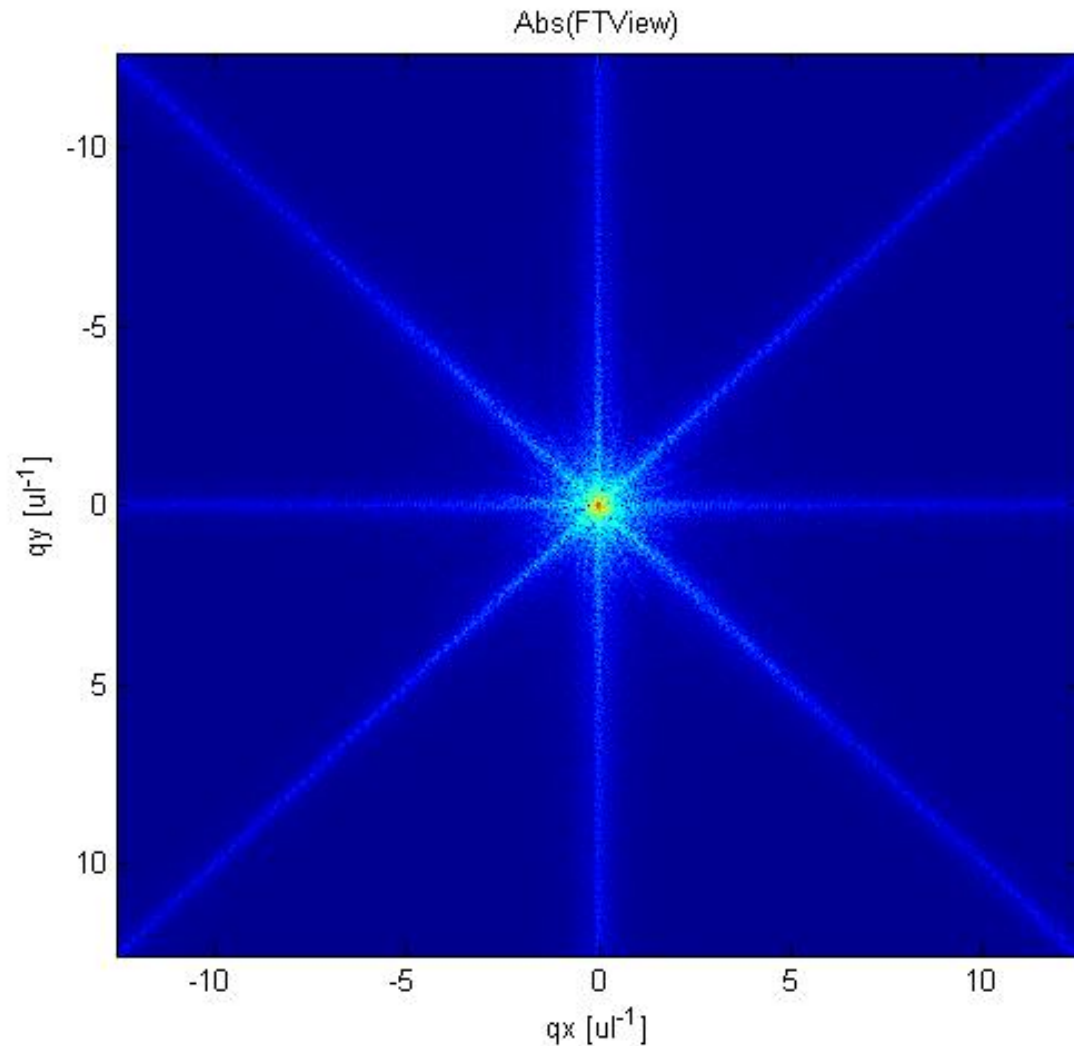
Noise level vs. Smoothing Amount

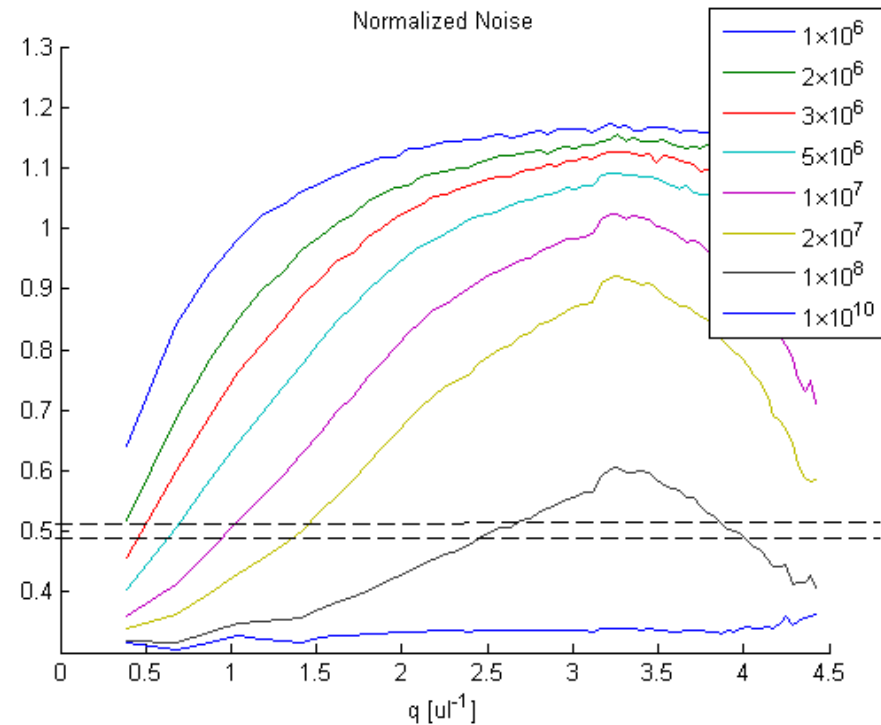
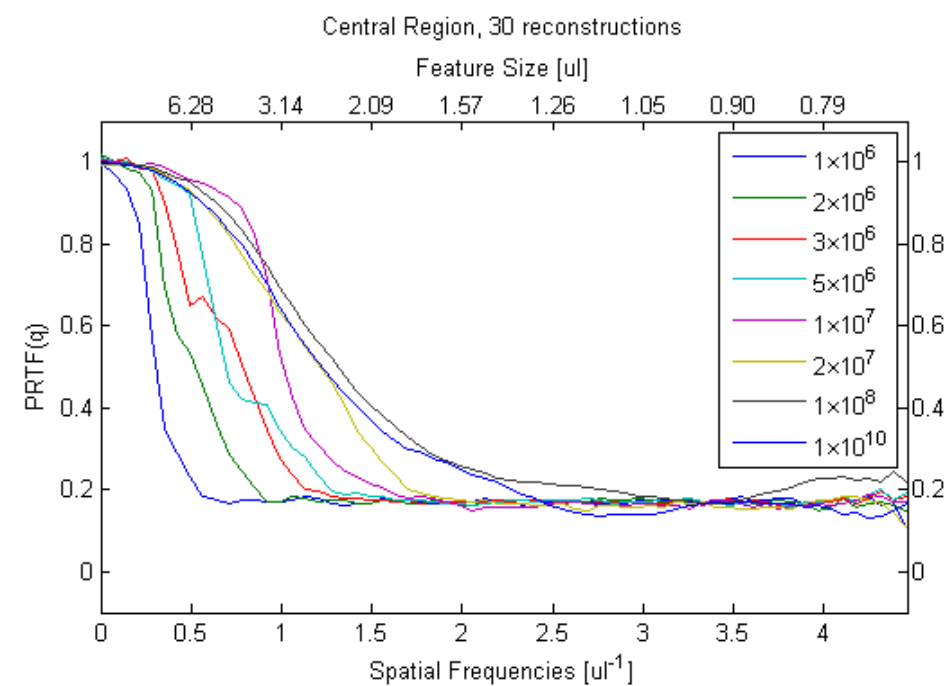


Test Object and Probe

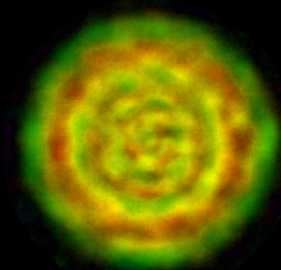
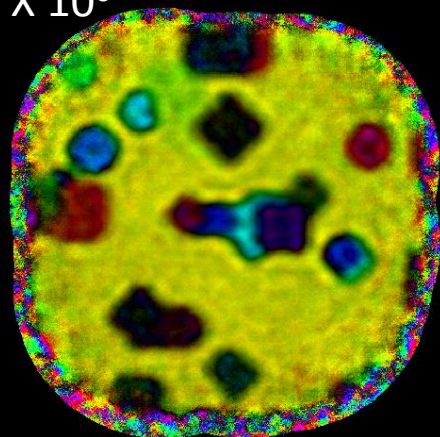


Strong favoring of Spatial Frequencies

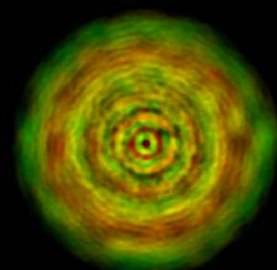
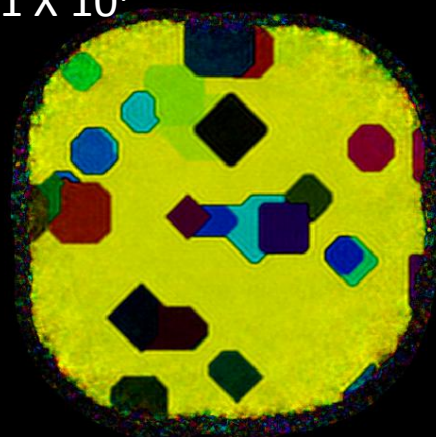




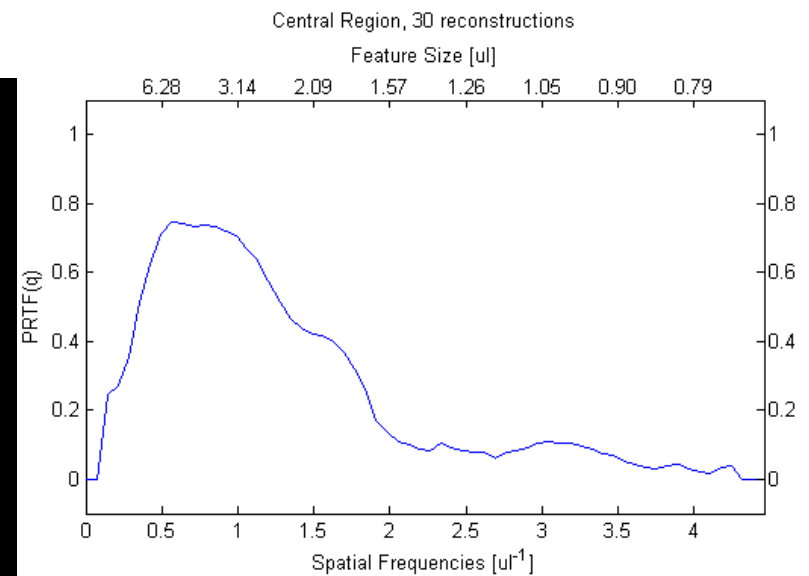
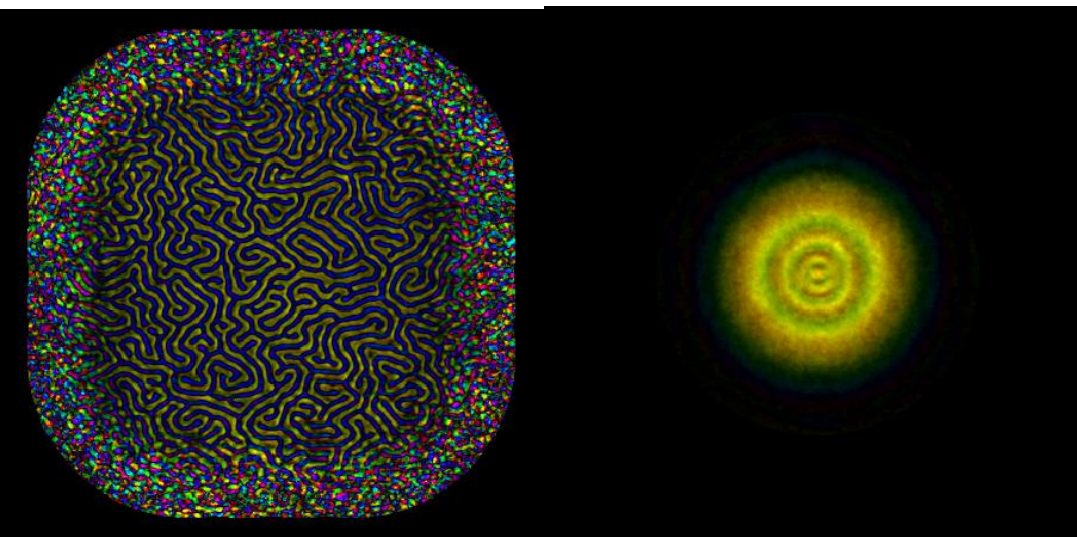
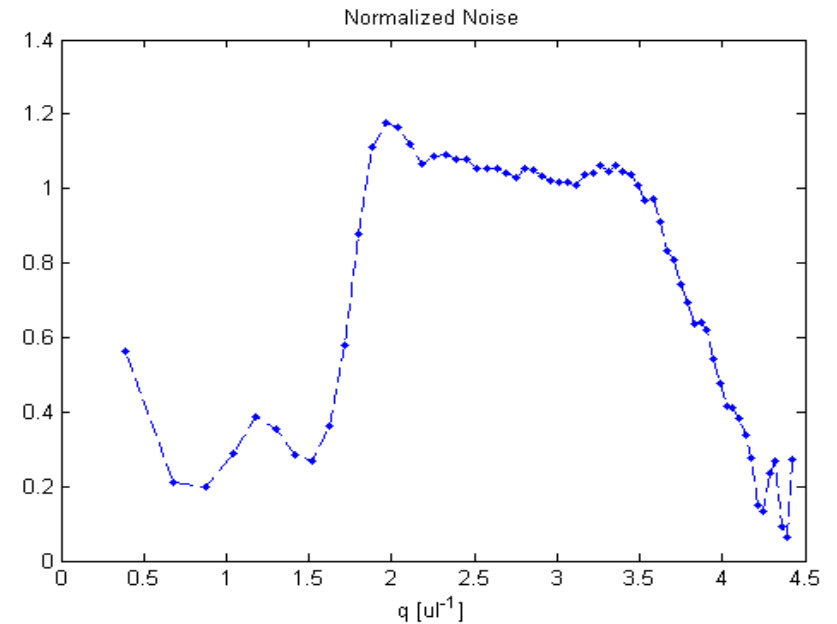
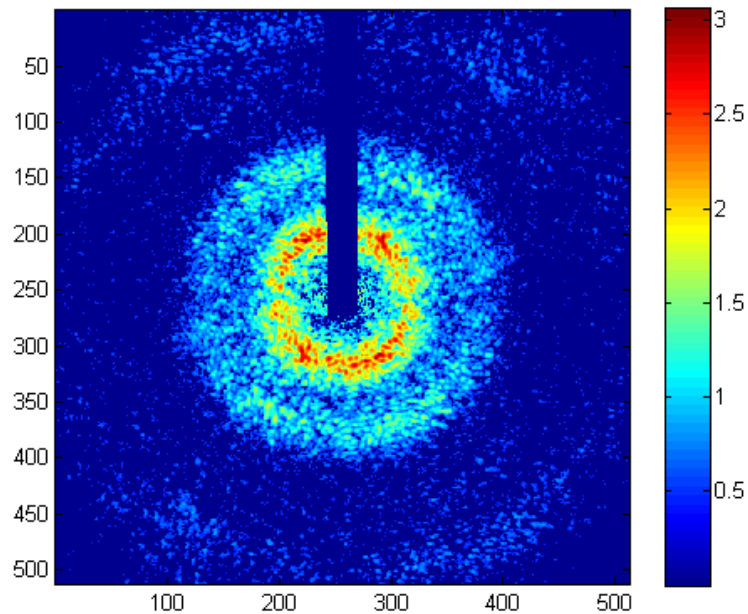
1×10^6



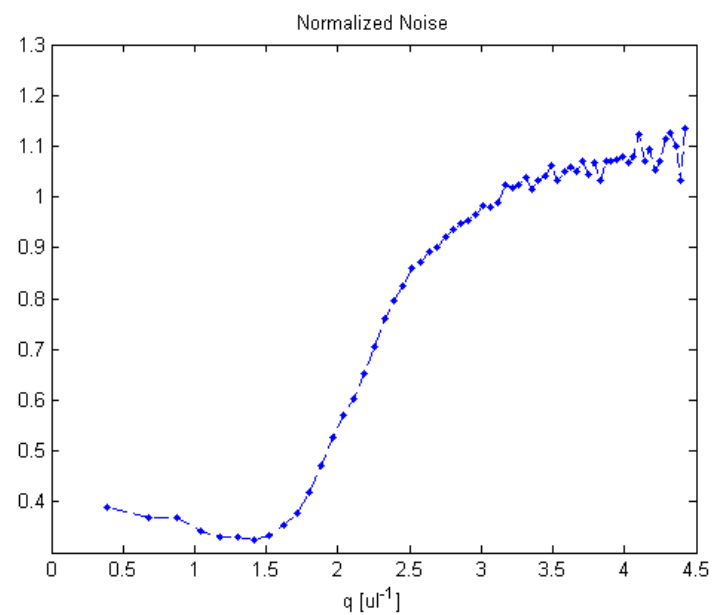
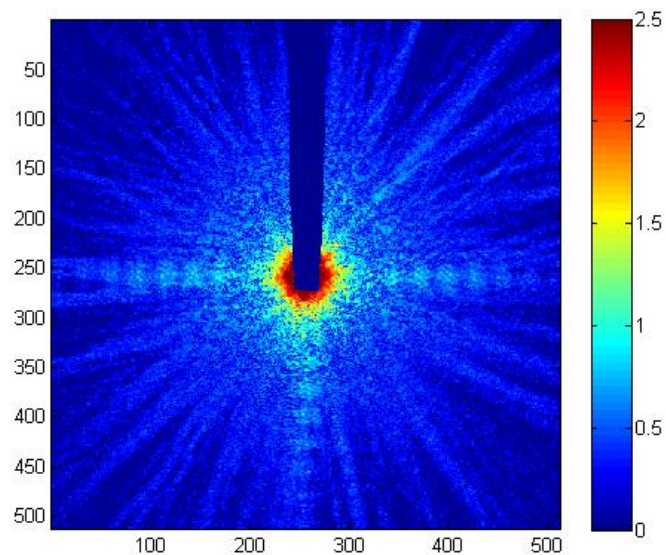
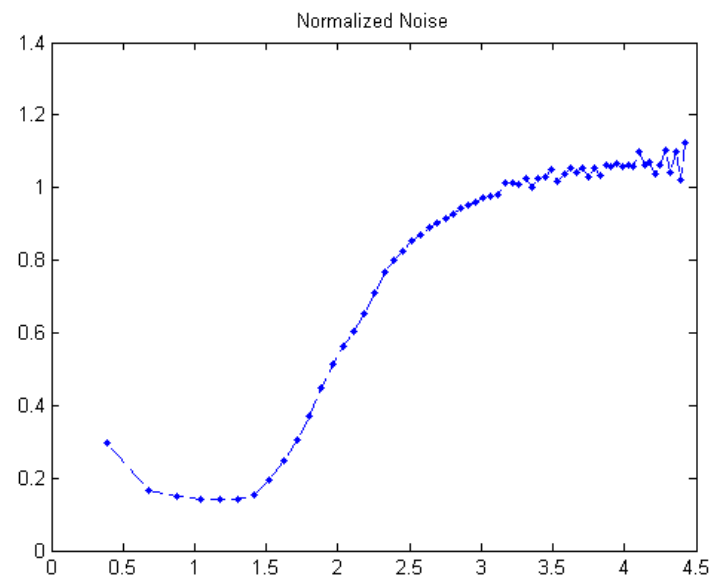
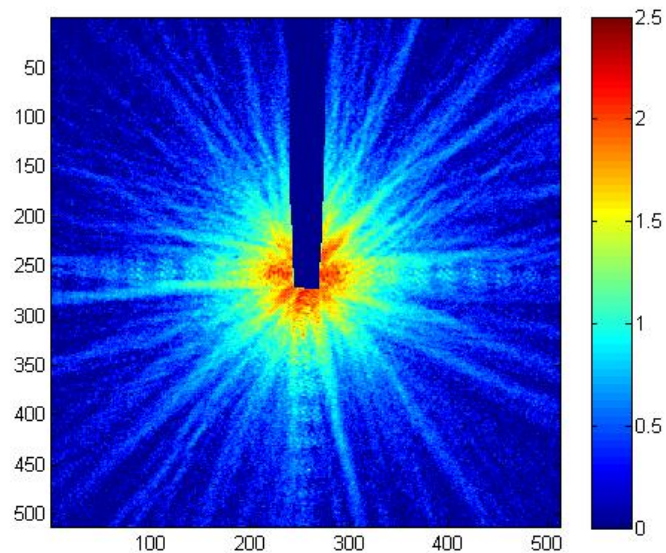
1×10^7



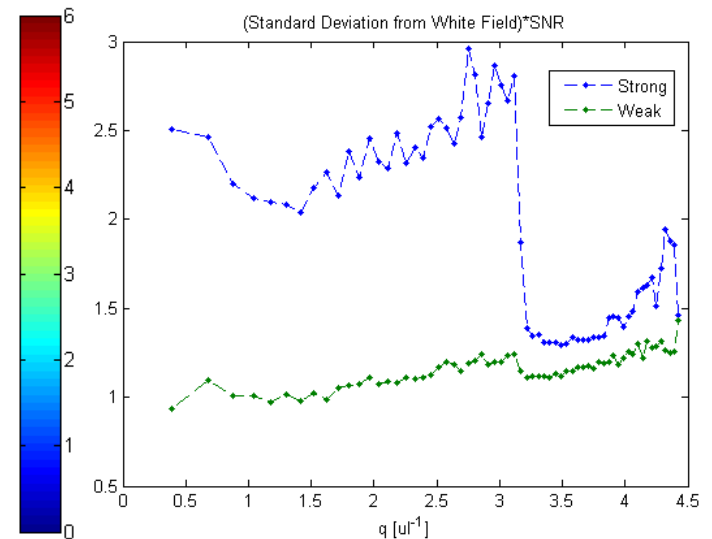
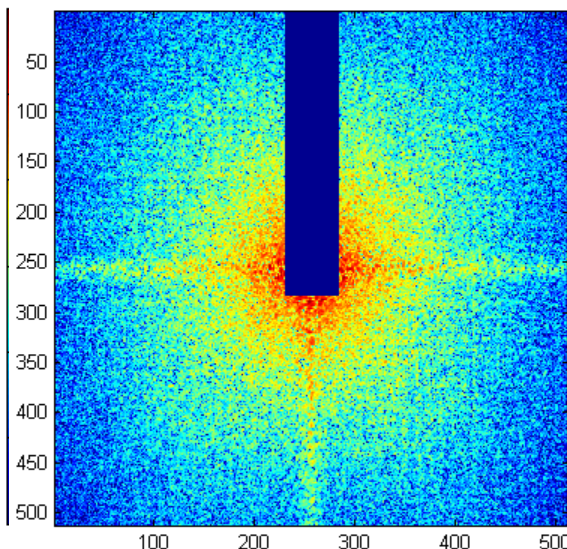
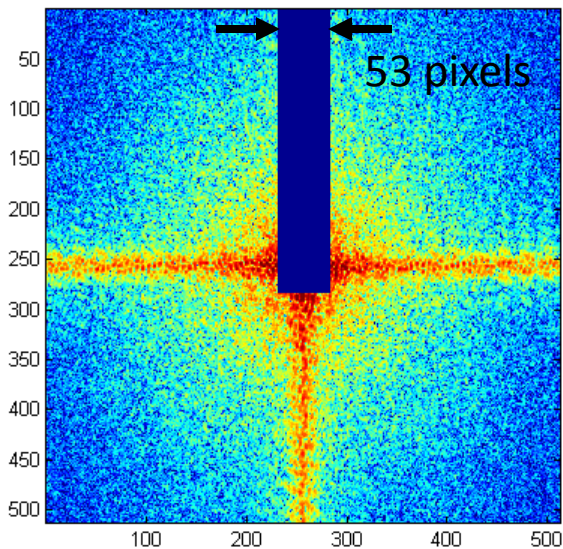
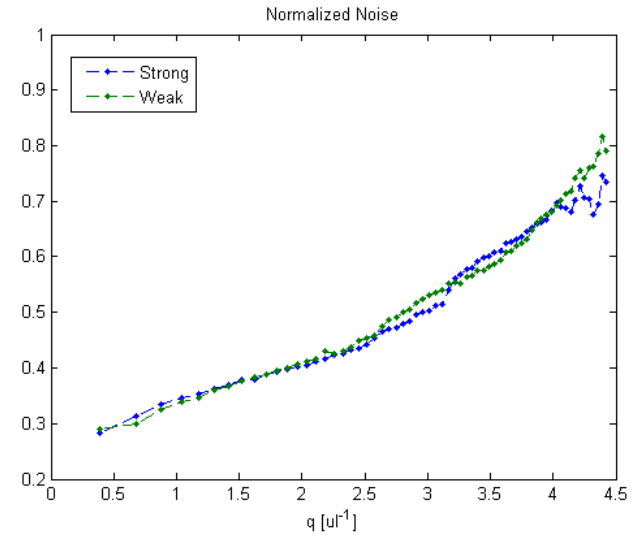
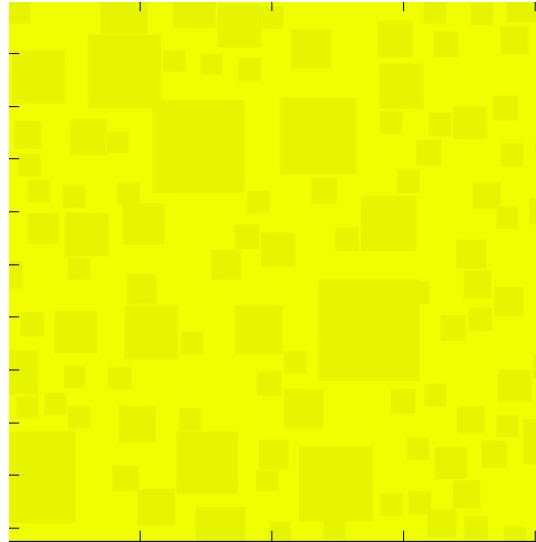
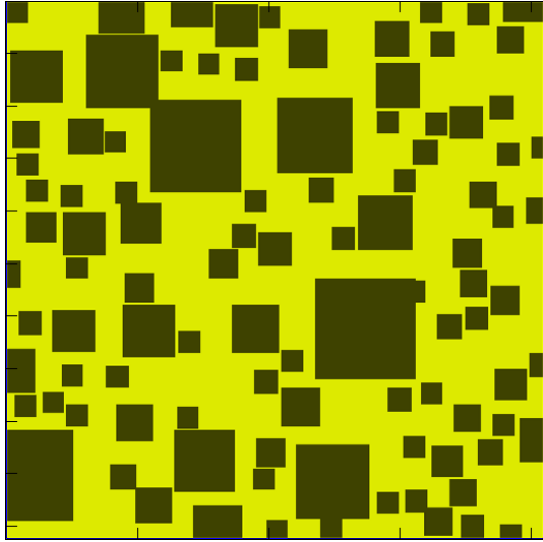
GdFe2009 Magnetic



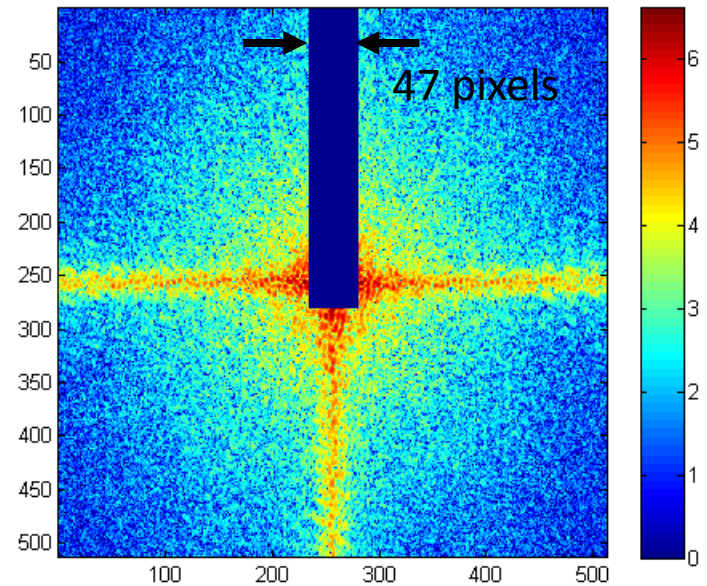
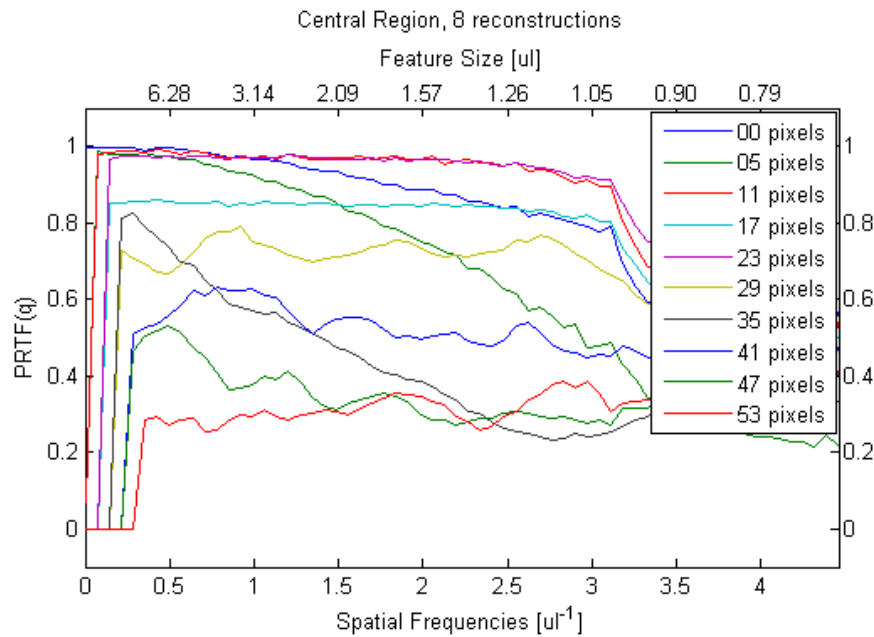
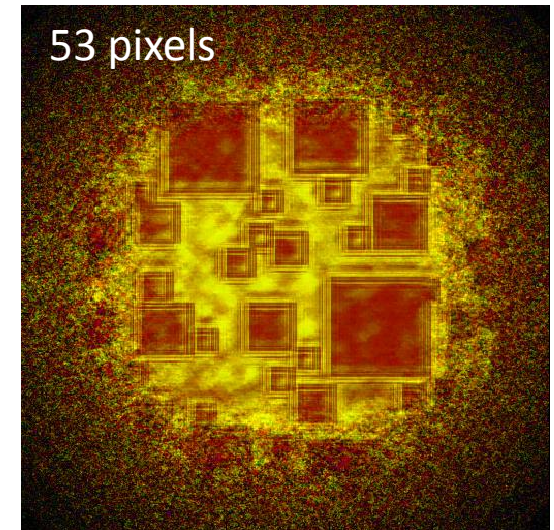
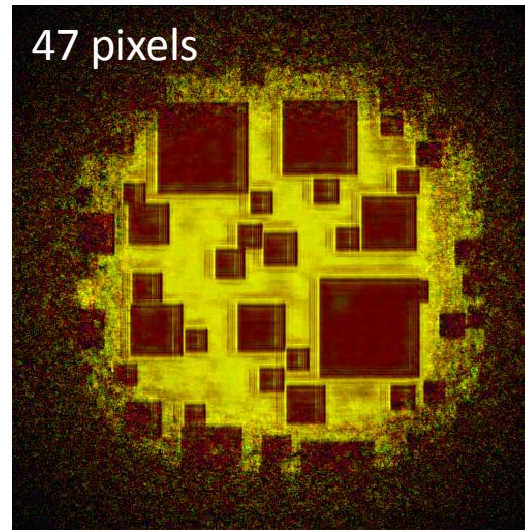
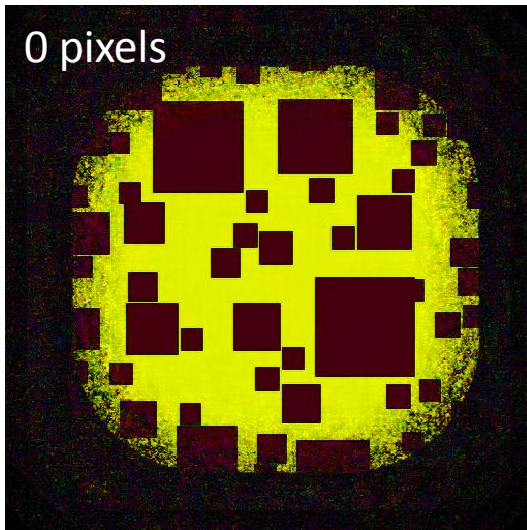
GdFeAu 2011 Charge



Missing Data and Noise with 7×10^7 ph



Strong Contrast



Weak Contrast

